Electricity Calculations

Name: _____

Use the five step method to solve the following problems.

1. Calculate the voltage drop across the following loads:
   a. A bulb that has 2.4 A flowing through it. The resistance of the bulb is 16Ω

$I = 2.4\,A$
$R = 16\,\Omega$
$V = ?$

$V = IR$ $\quad V = 2.4A(16\Omega)$

$V = 38.4\,V$

The voltage drop is 38.4 V.

   b. A coffee grinder that has a resistance of 85.0 Ω and a current of 1.41 A.

$R = 85.0\,\Omega$
$I = 1.41\,A$
$V = ?$

$V = IR$ $\quad V = 1.41A(85.0\Omega)$

$V = 119.85\,V$

The voltage is 119.85 V.

   c. A current of 0.024 A flowing through a resistance of 750 Ω.

$I = 0.024\,A$
$R = 750\,\Omega$
$V = ?$

$V = IR$ $\quad V = 0.024A(750\Omega)$

$V = 18\,V$

The voltage is 18 V.

2. Calculate the energy released from a battery in a hand vacuum cleaner that was switched on for 45 s. The voltage drop was 6 V and the current was 0.30 A.

$\Delta t = 45\,s$
$V = 6\,V$
$I = 0.30\,A$
$E = ?$

$E = VI\Delta t$

$E = 6V(0.30A)(45s)$

$E = 81\,J$

The vacuum cleaner used 81 J.

3. Calculate the energy released from a portable radio using a 9 V battery. The current was 0.5 A and it operated for 2.5 h.

$E = ?$
$I = 0.5\,A$
$V = 9\,V$
$\Delta t = 2.5\,h = 9000\,s$

$E = VI\,\Delta t$
$E = 9\,V(0.5\,A)(9000\,s)$
$E = 40500\,J$

or $E = 9\,V(0.5\,A)(2.5\,h)$
$E = 11.25\,Wh$

4. Calculate the power rating of an electric toaster that uses 210 000 J while toasting bread for 140 s.

$P = ?$
$E = 210000\,J$
$\Delta t = 140\,s$

$P = \frac{E}{\Delta t}$
$P = \frac{210000\,J}{140\,s}$
$P = 1500\,W$

The power rating is 1500W.

5. Calculate the power rating of a coffee grinder that operates on a voltage of 120 V. A current of 1.7 A flows through the motor.

$P = ?$
$V = 120\,V$
$I = 1.7\,A$

$P = VI$
$P = 120\,V(1.7\,A)$
$P = 204\,W$

The power rating is 204W.

6. Calculate the percent efficiency of an electric motor that uses 15 000 J of energy to produce 11 500 J of useful movement.

efficiency = ?
Input = 15000J
Output = 11500J

$\text{efficiency} = \frac{\text{Output}}{\text{Input}} \times 100\%$
$\text{efficiency} = \frac{11500\,J}{15000\,J} \times 100\%$
$\approx 77\%$

The efficiency is about 77%

7. Calculate the percent efficiency of an incandescent light bulb that produces 2500 J of light energy from 50 000 J of electrical energy.

efficiency = ?
output = 2500J
input = 50000J

$\text{eff.} = \frac{\text{out}}{\text{in}} \times 100\%$
$\text{eff} = \frac{2500\,J}{50000\,J} \times 100\%$
$\text{eff} \approx 5\%$

The efficiency is 5%.

8. Calculate the energy used by a coffee maker that has a power rating of 0.900 kW and operated for 17 h.

$E = ?$
$P = 0.900\,kW$
$\Delta t = 17\,h$

$E = P\Delta t$
$E = 0.900\,kW\,(17\,h)$
$E = 15.3\,kWh$

The coffee maker uses about 15.3 kWh.

9. How much energy is used by a 1.5 kW electric kettle that operates for 0.80 h per day for two weeks?

$P = 1.5\,kW$
$\Delta t = 0.80\,h\,(14) = 11.2\,h$
$E = ?$

$E = P\Delta t$
$E = 1.5\,kW\,(11.2\,h)$
$E = 16.8\,kWh$

16.8 kWh is used.

10. Calculate how much energy a colour TV that has a power rating of 0.120 kW uses in one week if it operates 9 h per day every day.

$P = 0.120\,kW$
$\Delta t = 9\,h\,(7) = 63\,h$
$E = ?$

$E = P\Delta t$
$E = 0.120\,kW\,(63\,h)$
$E = 7.56\,kWh$

The TV uses 7.56 kWh of energy.

11. Calculate the cost of operating each of the devices in question # 8 – 10 if electrical energy costs \$0.08 per kW·h.

#8
cost = E x rate
Cost = 15.3 kWh ($0.08/kWh)
Cost = $1.224
≈ $1.22

#9
cost = 16.8 kWh ($0.08/kWh)
cost = $1.344
≈ $1.34

#10
cost = 7.56 kWh ($0.08/kWh)
cost = $0.6048
≈ $0.60 or 60¢